Office européen des brevets

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(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89110724.5

(51) Int. Cl.4: G06F 3/033 , G06K 11/06

(22) Date of filing: 13.06.89

(30) Priority: 22.06.88 JP 154518/88

(43) Date of publication of application: 27.12.89 Bulletin 89/52

(84) Designated Contracting States: DE FR GB IT

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(54) Electronic blackboard and accessories such as writing tools.

(57) The present invention discloses an electronic blackboard apparatus comprising an electronic blackboard portion (1), a writing tool (3), an eraser (4), an instruction rod (2), a position detection portion (11), a writing tool determination portion, a data processing portion (5), and an output portion (52). When image information such as characters or figures are drawn on the writing surface (14) of the electronic blackboard portion by using the writing tool, when the region which is intended to be erased of the information which is being displayed is selected by the eraser, or when an assignment is carried out by using the instruction rod, information representing the type of the tool which is being used selected from a group consisting of the writing tool, eraser and instruction rod and the predetermined information about the position are supplied to the data processing portion via the position detection portion or the writing tool determination portion whereby display information corresponding to the display information which has been subjected to a predetermined process or instruction information by means of the instruction rod are output to the output portion.

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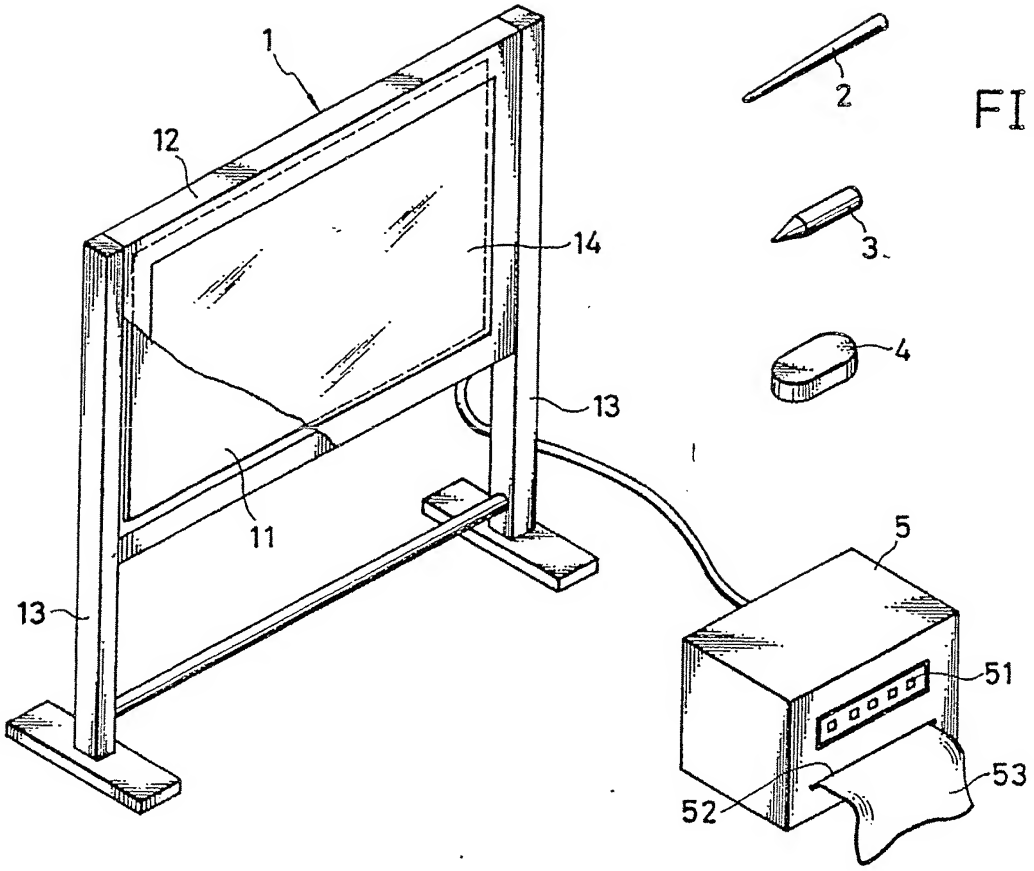

FIG.1

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electronic blackboard for processing image information which corresponds to the image or the like displayed on the writing surface and its accessaries such as writing tools.

Prior Art

Hitherto, there is a conventional electronic blackboard apparatus (called "an electromagnetic coupled type" hereinafter) arranged such that a multiplicity of sensing lines are, in both x and y directions, formed on the reverse side of the writing surface thereof and a writing tool comprising a felt pen or the like is provided with a coil as to generate flux change when an electronic current is passed so that the thus-generated flux change is detected by the sensing lines or the other end of the coil so that the position of the writing tool on the writing surface is detected and thereby image information which corresponds to the image displayed on the writing surface can be processed.

Another type of the electronic blackboard apparatus called "a photoelectric transfer type" hereinafter) is known which is arranged such that image written on a whiteboard or a flexible sheet with a writing tool such as a felt pen or the like is scanned by a scanner which can move along the surface of this whiteboard or by a stationary scanner with this sheet wound up as to be photoelectrically transferred to image information.

The other conventional electronic blackboard apparatus (called "a pressure sensing type" hereinafter) is known in which two resistance plates provided with electrodes on the opposing sides thereof are fastened to the reverse side of a writing surface made of a flexible material with laminated to each other. These two resistance plates are fastened to the same in such a manner that these electrodes are positioned in the vertical or lateral direction. Therefore, a displacement current is generated between this electrode and the electrode on the other resistance plate when the writing tool is moved along the surface of the writing surface with an electric current being passed through either of the two resistance plates. On the basis of the thus-generated displacement current, the position of the writing tool on the writing surface is detected so that image information corresponding to the image displayed on the writing surface is processed.

However, the above-described electromagnetic coupling type apparatus arises a problem in that, a cord needs to be provided between the control unit for detecting the position and the coil provided for the writing- tool. The thus-provided cord deteriorates readiness in handling the writing tool.

In the photoelectrically transfer type apparatus, the writing tool can be arranged to be a cord-less type. However, another problem arises in that information corresponding to the displayed image cannot be obtained during writing of the image on the writing surface, that is real-time image cannot be obtained since image information can be first obtained when the scanner is moved or the sheet is wound up.

In the pressure sensing type apparatus, the writing tool can be arranged to be a cord-less type and the information corresponding to the image which is being written can be obtained. However, a problem arises in that the thickness and the weight become excessive since the structure needs to be formed so as to withstand the pressure applied with the writing tool to the writing surface.

SUMMARY OF THE INVENTION

A first object of the present invention is to provide an electronic blackboard apparatus capable of using a cord less accessary such as an instruction rod, a marker, or an eraser (called a "writing tool" hereinafter in this specification), obtaining realtime image information which corresponds to the image formed on the writing surface, and exhibiting a thin structure and light weight.

In order to achieve this first object, an electronic blackboard apparatus according to the present invention comprises: a writing tool or the like including a tuning circuit which includes at least a coil and a capacitor, and in which a predetermined frequency is arranged to be the tuning frequency thereof; a sensing portion including electric wave generating means for generating electric wave that can synchronize with the tuning frequency and an electric wave detection means for detecting electric wave reflected by the tuning circuit; coordinate detection means for transmitting and receiving signals between the writing tool or the like and the sensing portion for the purpose of detecting, in response to the signals, the coordinate which corresponds to the position assigned by the writing tool or the like; and image information

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processing means for processing, on the basis of the thus-detected coordinate, image information which corresponds to images or the like formed on a writing tool or the like.

According to the electronic blackboard apparatus according to the present invention, when an electric wave is generated by the electric wave generating means in the sensing portion, the thus-generated electric wave synchronized with the tuning circuit for the writing tool or the like which assigns writing or the like in the sensing portion, that is, the same is received. The tuning circuit which has received this electric wave transmits a similar electric wave, that is, receives it. The thus-reflected electric wave is detected by the electric wave detection means in the sensing portion so that the coordinate of the writing tool or the like on the surface of the sensing portion is detected by the coordinate detection means. Furthermore, image information corresponding to the image or the like on the writing surface is processed by the image information processing means on the basis of the thus-detected coordinate.

Therefore, it needs for the writing tool or the like to be provided with only a tuning circuit comprising a coil and a capacitor as the main components thereof so that a cordless writing tool or the like can be realized. It causes for the handling readiness to be improved. Furthermore, since the position of the writing tool or the like can be detected only by obtaining a signal from the loop coil in the sensing portion, that is, it can be detected when the writing tool or the like is in use, image information corresponding to the image or the like on the writing surface can be obtained in a realtime manner. In addition, since the force to be applied with the writing tool or the like to the writing surface is limited to the same level as that of a force to be applied to a usual whiteboard with a usual marker or an eraser, the thickness and weight of the electronic blackboard according to the present invention can be made the same level of a usual whiteboard.

A second object of the present invention is to provide an electronic blackboard apparatus capable of identifying the type and the state of the writing tool which is being used and thereby obtaining image information which corresponds to the thus-identified type or state of the writing tool.

In order to achieve this second object, an electronic blackboard apparatus according to the present invention comprises: a writing tool or the like including a tuning circuit whose tuning frequency is changed from any tuning frequency of a plurality of frequencies to another frequency in accordance with any of a plurality of tuning circuits each of which has an individual frequency or the state of the same; signal generating means for generating AC signals having individual frequencies; signal detection means for detecting AC signals having individual frequencies; writing tool identification means for generating identification information expressing, on the basis of the AC signal detected by the signal detection means from x and y-direction loop coils, the type or the state of the writing tool or the like which is being used on the sensing portion; and image information processing means for processing image information which corresponds to the image on the writing surface on the basis of the x and y-direction coordinates of the writing tool or the like and identification information expressing the type or the state of the writing tool or the like which is being used.

According to an apparatus of the type described above, on the basis of the electric wave generated in accordance with an induced voltage generated in the tuning circuit for the writing tool or the like used on the writing surface and received by the x and y-direction loop coils, the type or the state of use of the writing tool or the like on the writing surface is identified by the writing tool or the like identification means. As a result, identification information is transmitted so that image information corresponding to the image formed on the writing surface can be processed on the basis of this identification information with the x and y-direction coordinates of the writing tool or the like.

Therefore, since the type or the state of use of the writing tool or the like selected to be used on the writing surface can be correctly recognized easily, causing labor needed when such information is input through a keyboard can be eliminated. In addition, an erroneous information inputting can be prevented. As a result, image information exhibiting a great quantity of information by virtue of a multiplicity of types of the writing tools or a writing tool exhibiting a multiplicity of states can be always and accurately obtained.

A third object of the present invention is to provide an electronic blackboard apparatus including two writing surfaces.

In order to achieve this third object, an electronic blackboard apparatus according to the present invention comprises: writing surfaces disposed on both sides of the sensing portion and capable of being used repeatedly; means for detecting the surface which is being used for detecting the writing surface which is being used from writing surfaces; and coordinate conversion means for outputting, intact or after the coordinates have been converted on the basis of the writing surface which is being used, x and y-direction coordinates of the writing tool or the like outputted from the coordinate detection means.

According to an apparatus of the type described above, when the writing tool or the like is

writing tool or the like can be outputted, for example, intact, by the coordinate conversion means on the basis of information relating to use of the one writing surface output from the writing surface detection means. On the other hand, the writing tool is used on the other writing surface, the coordinate of the same is outputted after the this coordinate has been converted by the coordinate conversion means on the basis of information relating to use of the other writing surface Output from the writing surface detection means.

Therefore, since image information obtainable when one surface is used and the same when another surface is used become the information with respect to one coordinate axis, the electronic blackboard apparatus can be freely used regardless of consciousness of the writing surface which is being used.

A fourth object of the present invention is to provide a writing tool such exhibiting a simple structure, light weight, and easy handling capability, that is, an instruction rod, a marker, and an eraser.

In order to achieve this fourth object, writing tools according to the present invention are as follows:

an instruction rod in which a tuning circuit formed by at least a coil including a core and a capacitor and having a tuning frequency arranged to be a predetermined frequency is accommodated in the main body of a rod-like body having a predetermined length when used;

marker formed by a pen body such as a felt pen or the like and a tuning circuit comprising at least a coil including a core and a capacitor in which a tuning frequency is arranged to be a predetermined frequency, these pen body and the tuning circuit being accommodated in a frame as to enable writing with the pen body on the writing surface; and

an eraser comprising an erasing member having a predetermined area and a tuning circuit comprising at least a coil including a core and a capacitor and in which the tuning frequency is arranged to be a predetermined frequency, said erasing member and said tuning circuit being accommodated in the frame so that images formed on the writing surface can be erased by the erasing member.

According to the instruction rod according to the present invention, when the image information on the writing surface is assigned by the rod-like main body, electric wave can be transmitted between the tuning circuit and the sensing portion so that the coordinate can be input. According to the marker, when the frame is operated on the writing surface, electric wave can be transmitted between the tuning circuit and the sensing portion so that the writing surface can be erased by the erasing member.

Therefore, since the writing tool or the like according to the present invention are structured similarly to the conventional writing tools or the like except for the difference lies in that the tuning circuit formed by very small and light weight components such as a coil and a capacitor is provided, the structure and weight of the writing tools for inputting the assigned point, for drawing an image on the writing surface, and for erasing the image on the writing surface can be simplified and reduced. Therefore, the handling of these writing tool or the like can be made easy.

Other objects and features of the present invention will become more apparent in the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view which illustrates a first embodiment of an electronic blackboard apparatus according to the present invention;

Fig. 2 is a structural view which illustrates loop coil groups in X and Y directions of a sensing portion;

Fig. 3 is a cross-sectional view which illustrates an instruction rod;

Fig. 4 is a cross-sectional view which illustrates a marker;

Fig. 5 is a cross-sectional view which illustrates an eraser;

Fig. 6 is a block diagram which schematically illustrates the electric system of the electronic blackboard apparatus according to the present invention;

Fig. 7 is a view which illustrates each of tuning circuits for a writing tool and details of a control unit for the sensing portion;

Fig. 8 is a view which illustrates the waveform of each of the signals;

Fig. 9 is a view which illustrates an example of the transition of switch signals;

Fig. 10 is a flow chart about the process relating to the coordinate-detection action performed by the control unit for the sensing portion;

Figs. 11A, 11B, and 11C are views which illustrate timing of the coordinate detection action performed by the control unit of the sensing portion;

Fig. 12 is a view which illustrates levels of the detected voltage obtainable from each of the loop coils when the coordinate detection action is performed;

Fig. 13 is a view which illustrate the structure of a data processing unit;

Fig. 14 is a flow chart about a process relating to processing of image information performed by the data processing unit;

Fig. 15 is a view which illustrates a second embodiment of the electronic blackboard apparatus according to the present invention;

Fig. 16 is a view which illustrates a partial cross-sectional view which illustrates a frame according to the second embodiment;

Fig. 17 is a flow chart which illustrates a program for the data processing unit according to the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a view which illustrates a first embodiment of an electronic blackboard apparatus according to the present invention, wherein reference numeral 1 represents a main blackboard body, 2 represents an instruction rod, 3 represents a marker, 4 represents an eraser, and 5 represents a control box.

The main blackboard body 1 is formed such that legs 13 are fastened to a frame 12 a portion of which corresponds to the front surface of a sensing portion 11 is made of a non-metallic material having a flat surface so as to form a writing surface 14 which can be repeatedly used with the marker 3 and the eraser 4. Alternatively, the portion of the frame 12 which corresponds to the front surface of the sensing portion 11 may be formed by applying paint to which magnetic dust is mixed to the plate made of the non-metallic material or by laminating a film sheet such as a magnet sheet and a plastic sheet on the same plate for the purpose of realizing a writing surface to which sheet in which intended frames or figures are written can be temporally fastened by metal pieces or magnets.

Fig. 2 is a view which in detail illustrates a loop coil groups 11x in x-direction and a loop coil group 11y in y-direction which form the sensing portion 11. The loop coil group 11x in x-direction comprises a multiplicity of, for example, 48 loop coils 11x-1, 11x-2,..., 11x-48 so as to be arranged in parallel to each other and to overlap each other. The loop coil group 11y in y-direction comprises a multiplicity of, for example, 30 loop coils 11y-1, 11y-2,..., 11y-30 so as to be arranged in parallel to each other and to overlap each other. The loop coil group 11x in x-direction and the loop coil group 11y in y-direction overlap each other with positioned closely contact with each other (in order to readily understand the structure, they are drawn in a separated manner). Alternative to the structure employed here in which each of the loop coils is formed by one turn, the loop coils may be formed by a plurality of turns if necessary.

Fig. 3 is a view which illustrates a first embodiment of the writing tool and so on according to the present invention, in which the structure of the instruction rod 2 is illustrated. This instruction rod 2 is made of a synthetic resin, wood or the like and is formed in such a manner that a tuning circuit 22 comprising a coil 221 which includes a core and a capacitor 222 is accommodated in a recessed portion 21a formed at the front end portion of a column-like main body 21 made of a synthetic resin or wood in such a manner that the axis of this coil 221 substantially meets the longitudinal direction of the main body 21 (frame), and this recessed portion 21a is covered with a cap 23 made of the similar material to that for the main body 21. The main body 21 may comprise a telescopic rod.

The coil 221 and the capacitor 222 are, as shown in Fig. 7, connected to each other in series so as to form a known resonant circuit. The inductance of this coil 221 and the capacity of the capacitor 222 are determined as to make the resonant (tuned) frequency thereof substantially a predetermined frequency f0, for example, 600 kHz.

Fig. 4 is a view which illustrates a second embodiment of the writing tool according to the present invention, in which the structure of a marker 3 is in detail illustrated. This marker 3 comprises: a pen shaft 31 formed by two portions 31a and 31b made of a non-metallic material such as a synthetic resin and to be screw-coupled with each other; a pen body 32 such as a black felt pen on the market or the like; a push switch 331; a coil 332 including a core; a tuning circuit 33 comprising capacitors 333 and 334; and a cap 34 for the pen body 32.

The pen body 32 is accommodated in a space formed by a stopper 31a′ formed in the portion 31a of the pen shaft 31 and the switch 331 accommodated in the portion 31b such that the same can be slightly moved therein. The coil 332 is accommodated in the portion at the front end of the portion 31a of the pen shaft 31 such that the axial direction thereof can be substantially meet the longitudinal direction of the pen shaft 31 (frame).

As shown in Fig. 7, the coil 332 and the capacitor 333 are connected to each other in series so as to form a known resonant circuit. The inductance of this coil 332 and the capacity of the capacitor 333 are so determined as to make the resonant (tuned) frequency thereof substantially a predetermined frequency f0, for example, 600 kHz. The capacitor 334 is in parallel connected to the two ends of the capacitor 333 via the switch 331 so that the same acts to change the tuned frequency

quency f0 to another frequency f1, for example, 550 kHz when the above-described switch 331 is switched on.

This switch 331 is arranged to be switched on when it is abutted by the rear end of the pen body 32 which has been pushed into the pen shaft 31 as a result of abutting the front end of the pen body 32 against the writing surface 14 or the like with the pen shaft 31 held by the hand or the like.

Although the front end of th pen body is made project over the writing surface as to enable the writing according to this embodiment, it may be arranged to be capable of projecting only when used. The marker is so designed that the pen body 32 included therein can be replaced by so arranging the pen shaft 31 that it can be divided and coupled to each other.

Fig. 5 is a view which illustrates a third embodiment of the writing tool or the like according to the present invention, in which the structure of the eraser 4 is illustrated in detail. This eraser 4 comprises: a case 41 made of a non-metallic material such as a synthetic resin or the like; a movable plate 42 comprising a pair of members 42a and 42b each of which has a shape corresponding to the bottom surface of the case 41 and which are arranged to be detachable to each other; a pair of springs 43a and 43b inserted between the movable plate 42 and the case 41; a stopper 44 disposed in an inner portion 41a of the case 41 and capable of supporting a securing portion 42b' which projects in the direction of the member 42b perpendicular to the drawing sheet for the purpose of restricting the position of the movable plate 42 with respect to the case 41; an erasing member 45 made of felt or the like and fastened to the outer surface of the member 42a of the movable plate 42; a first tuning circuit 46 comprising a switch 461 accommodated in the inner portion 41a of the case 41, a capacitor 462 and a coil 463 which includes a core and is held between the members 42a and 42b at the position corresponding to the spring 43a of the movable plate 42 such that the axial direction thereof and the erasing surface formed by the erasing member 45 are substantially perpendicular to each other; and a second tuning circuit 47 comprising a switch 471, a capacitor 472, and a coil 473 which includes a core and is held between the members 42a and 42b at the position corresponding to the spring 43b such that the axial direction thereof and the erasing surface formed by the erasing member 45 are substantially perpendicular to each other. This movable plate 42 is held such that the same can move slightly with respect to the case 41 so that the switch 461 and/or 471 can be operated.

The coil 463 and the capacitor 462 are connected to each other in series via the switch 461 as shown in Fig. 7 so that a known resonant circuit is actuated when this switch 461 is switched on. The inductance of this coil 463 and the capacity of the capacitor 462 are determined as to make the resonant (tuned) frequency thereof substantially another frequency f2, for example, 500 kHz.

The coil 473 and the capacitor 472 are connected to each other in series via the switch 471 as shown in Fig. 7 so that a known resonant circuit is actuated when this switch 471 is switched on. The inductance of this coil 473 and the capacity of the capacitor 472 are determined as to make the resonant (tuned) frequency thereof substantially other frequency f3, for example, 450 kHz.

These switches 461 and 471 are switched off when the eraser 4 is not operated, while either or both of the switches 461 and 471 are switched on by being pressed by the member 42b of the movable plate 42 when the erasing member 45 of the movable plate 42 is pushed into the case 41 by abutting this erasing member 45 against the writing surface 14 or the like with the case 41 held by the hand or the like.

The tuning circuit for the writing tool or the like of the type described above is so arranged that it can synchronize with the energy of the electric wave discharged from the electric wave generating means in the sensing portion and discharge this energy to the electric wave detection means in the sensing portion for the purpose of meeting the conditions required to perform indication of the position to be measured to the sensing portion.

The control box 5 is provided with, on the front surface thereof, various control switches 51 and an outlet 52 through which printed sheets are discharged, this control box 5 including, as shown in Fig. 6, the sensing portions control unit 6, the data processing unit 7, and a printer 8.

Fig. 7 is a view which in detail illustrates the sensing portion control unit 6 together with the instruction rod 2, the marker 3, the tuning circuits 22, 33, 46, and 47 for the eraser 4. Referring to this drawing, reference numeral 601 represents a control circuit, 602 represents a signal generating means (circuit), 603x and 603y respectively represent selection means (circuit) in x-direction and y-direction, 604x an 604y represent transmission and reception switch circuits, 605 represents a XY switch circuit, and 606 represents a reception timing switch circuit, whereby connection switch means is formed. Reference numeral 607 represents a BPF (Band-Pass Filter) which forms a signal detection means. Reference numeral 608 represents a detector and 609 represents an LPF (Low-Pass Filter) which form coordinate detection means and writing tool or the like identification means in which a process performed by the control circuit

601 to be described later is included. Reference numerals 610 an 611 represent drive circuits, 612 and 613 represent amplifiers, and 614 represents an inverter.

The operation of the sensing portion control unit 6 with the structure thereof will be described. First, the signal transmission and receipt between the sensing portion 11 and the writing tool or the like and the thus-obtained signals will be described with reference to Fig. 8.

The control circuit 601 comprises a known type of a microprocessor or the like. It acts to: supply a frequency switch signals p1 and P2 (quadrual counter data)and a timing signal (start pulse) p3 to the signal generating circuit 602 in accordance with a flow chart to be described later; control the switching of the loop coils in the sensing portion 11 via the selection circuits 603x and 603y; control the switching of the coordinate detection direction performed by the XY switch circuit 605 and the reception timing switch circuit 606; analog-digital (A/D) convert the output data from the low-pass filter 609 for the purpose of obtaining the coordinate of the writing tool or the like by performing calculations to be described later; and supply the frequency switch signals p1 and p2 when the above-described coordinate is obtained to the data processing unit 7, these frequency switch signals p1 and p2 serving information representing the type or the state (a state of the switch for the marker 3) of the writing tool or the like.

The signal generating circuit 602 comprises a rectangular signal generators 602a, 602b, 602c, 602d, and 602e, and a multiplexer 602f for respectively generating predetermined frequencies f0, f1, f2, f3, and fk.

The rectangular signals having frequencies from f0 to f3 are arranged to be input to the multiplexer 602f whose switching is controlled in response to the switch signals p1 and p2. When the switching signals p1 and P2 are "00", the signal having the frequency f0 is output, when the same are "01", the signal having the frequency f1 is output, when the same are "10", the signal having the frequency f2 is output, and when the same are "11", the signal having the frequency f3 is output, the thus-generated signal being output in the form of a rectangular signal A. The thus-output rectangular signal A is converted to a sine-wave signal by a low-pass filter (omitted from illustration), and is then supplied to either the drive circuit 610 or 611 via the XY switch circuit 605.

A rectangular signal having the frequency fk, for example, 18.75 kHz, is transmitted to the transmission and reception switch circuits 604x and 604y in the form of a transmission and reception switch signal B, and is simultaneously inverted via the inverter 614 as to be transmitted to the reception timing switch circuit 606 in the form of a reception timing signal C. The rectangular signal generator 602e is reset by the start pulse p3.

The selection circuit 603x successively selects a loop coil from the x-direction loop coil group 11x, while the selection circuit 603y successively selects a loop coil from the y-direction loop coil group 11y, each of these selection circuits 603x and 603y acting in response to information supplied from the control circuit 601.

The transmission and reception switch circuit 604x alternately connect the thus-selected x-direction loop coil to the drive circuit 610 and the amplifier 612. The transmission and reception switch circuit 604y alternately connect the thus-selected y-direction loop coil to the drive circuit 611 and the amplifier 613. These transmission and reception switch circuits 604x and 604y act in accordance with the transmission and receipt switch signal B.

It is assumed that "00" has been, together with the start pulse p3, supplied from the control circuit 601 to the signal generating circuit 602 in the form of the switch signals p1 and p2 and information to select x-direction has been input to the XY switch circuit 605 and the reception timing switch circuit 606, the sine-wave signal having the frequency f0 is supplied to the drive circuit 610 in which it is converted to an equilibrium signal before being supplied to the transmission and reception switch circuit 604x. Since this transmission and reception switch circuit 604x switches and connects either of the drive circuit 610 or the amplifier 612 in response to the transmission and reception switch signal B, a signal to be output from the transmission and reception switch circuit 604x to the selection circuit 603x becomes a signal D which intermittently outputs a sine-wave signal 600 kHz every time period T (= 1/2 fk), where it is substantially 27 μsec here.

This signal D is transmitted to the x-direction loop coil 11x-i (i = 1, 2, ...,48) in the sensing portion 11 via the selection circuit 603x, this loop coil 11x-i generating an electric wave on the basis of the signal D.

In this state, when the writing tool, for example, the marker 3 is held substantially vertically on the writing surface 14 of the main blackboard body 1 with the switch 331 switched off, the above-described electric wave excites the coil 332 of the marker 3 so that an induced voltage E synchronized with the signal D is generated in the tuning circuit 33 of the coil 332.

When the state of the signal D is then brought to a no-signal period, that is, signal reception period and simultaneously the loop coil 11x-i is switched to the amplifier 612, the electric wave from this loop coil 11x-i is immediately eliminated.

voltage E is gradually damped in accordance with loss in the tuning circuit 33.

On the other hand, the electric current passing through the tuning circuit 33 in accordance with this induced voltage E causes the coil 332 to transmit an electric wave. Since the thus-transmitted electric wave excites the loop coil 11x-i connected to the amplifier 612 on the contrary, an induced voltage on the basis of the electric wave from the coil 332 is generated. The thus-generated induced voltage is transmitted from the transmission and reception switch circuit 604x to the amplifier 612 during only the signal reception period so that it is amplified to become a reception signal F, and is then transmitted to the reception timing switch circuit 606.

Either of the selection information in x-direction or y-direction, the x-direction selection information and the reception timing signal C in this case, are input to the reception timing switch circuit 606. When this signal C is at the high (H) level, a reception signal F is output, while no signal is output when the same is at the low (L) level. Therefore, a signal G (substantially the same as the reception signal F) is obtained at the output of the reception timing switch circuit 606.

Since this signal F is transmitted to the band-pass filter 607 which is a filter including the frequency f0 to f3 in its band-pass region, a signal H (strictly, in the state in which a plurality of signals G have been input to and converged in the band-pass filter 607) having an amplitude h in accordance with energy of the frequency components from f0 to f3 in the above-described signal G transmitted to the detector 608.

The signal H input to the detector 608 is detected and rectified as to be made a signal I. Then, this signal I is converted into a direct current J having a voltage level corresponding to a half of the above-described amplitude h, for example, Vx by a low-pass filter 609 with a sufficiently low cut-off frequency as to be transmitted to the control circuit 601.

The voltage level Vx of the signal J relates to the distance between the marker 3 and the loop coil 11x-i, where it is a value in inverse proportion to substantially the fourth power of the distance between the marker 3 and the loop coil 11x-i. Therefore, when the loop coil 11x-i is switched, this voltage Vx of the signal J is varied. As a result, the x-coordinate of the marker 3 can be obtained by converting, in the control circuit 601, the voltages Vx obtained for each of the loop coils into digital values and by having the thus-obtained digital values subjected to the arithmetic process to be described later. The y-coordinate of the marker 3 can be obtained similarly.

writing surface 14, that is the sensing portion 11 are disposed away from each other, or when the marker 3 is disposed substantially in parallel to the sensing portion 11, the electric wave transmitted from the loop coil in the sensing portion 11 does not excite the coil 332 of the marker 3. Therefore, no induced voltage E is generated in the turned circuit 33. In this state, since also no electric wave is transmitted from the coil 332 of the tuning circuit 33, no induced voltage F is generated in the loop coil of the sensing portion during signal reception so that the coordinate cannot be detected (practically, a slight level of induced voltage is generated in both the turning circuit and the loop coil in the sensing portion, their levels are insufficient to perform the coordinate detection).

The above-described frequency switch signals p1 and p2 are the values counted by the quadrual ring counter formed by a program or the like in the control circuit 601. This counter is stepped to "1" when no reception signal, that is, no induced voltage is obtained in the control circuit 601 and the detection of the coordinate is thereby impossible to be performed. The value counted at this time is, together with the start pulse p3, arranged to be transmitted in the form of the switch signals p1 and p2 to the signal generating circuit 602. Therefore, during the period in which no reception signal is obtained, the frequency of the AC signal is successively switched from f0 to f3 so that the detection of the coordinate is performed by repeating this switching of the frequency.

If any reception signal is obtained, the x and y-coordinates can be obtained as described above. At this time, if the switch signal p1 and p2 are "00" or "01, that is if the frequency of the AC signal is f0 or f1, the above-described counter is not stepped so that the frequencies of the switch signals p1 and p2, that is the frequency of the AC signal is maintained intact. On the other hand, if the switch signal p1 and p2 are "10" or "11, that is if the frequency of the AC signal is f2 or f3, the above-described counter is stepped by "1" so that the frequencies of the switch signals p1 and p2, that is the frequency of the AC signal is successively switched.

As described above, when the tuning circuit 33 and the switch 331 of the marker 3 are turned off, the tuned frequency of the tuning circuit 33 of the marker 3 is f0, when the switch 331 is switched on, the tuned frequency of the tuning circuit 33 of the marker 3 is f1, when the switch 461 is switched on, the tuned frequency of the tuning circuit 46 of the eraser 4 is f2, and when the switch 471 is switched on, the tuned frequency of the tuning circuit 47 of the eraser 4 is f3. Therefore, if the switch signals p1 and p2 representing the frequency of the AC

signal are "00" when the reception signal can be obtained, a fact can be detected that the apparatus is used such that the instruction rod 2 or the pen body 32 of the marker 3 is not positioned in contact with the writing surface 14 and thereby the switch 331 is switched off. If the switch signals p1 and p2 are "01", a fact can be detected that the apparatus is used such that the pen body 32 of the marker 3 is positioned in contact with the writing surface 14 and thereby the switch 331 is switched on, that is, a fact can be detected that image is being written on the writing surface 14. If the switch signals p1 and p2 are "10" or "11", a fact can be detected that the apparatus is used such that the erasing member 45 of the eraser 4 is positioned in contact with the writing surface 14 and thereby the switch 416 or 471 is switched on, that is, a fact can be detected that the image on the writing surface is being erased.

Therefore, the switch signals p1 and p2 representing the frequencies of the AC signal when the above-described reception signal is obtained serve identification information representing the type or the state of use of the writing tool which is being used on the writing surface 14.

Fig. 9 is a view which illustrates an example of transition of the switch signals p1 and p2. First, when the writing tool or the like is positioned away from the writing surface 14, the switch signals p1 and p2 are successively switched as "00", "01", "10", and "11". When the writing tool or the like, for example, the marker 3 is allowed to come closer to the writing surface 14 with substantially erected, the coordinate is detected by the AC signal having the frequency f0, causing the AC signal having the frequency f0 to be generated repeatedly. Then, when the pen body 32 is brought into contact with the writing surface 14 (brought to a pen down state) between the time point t3 and t4, that is, when the switch 331 is switched on, the coordinate detection by means of the AC signal having the frequency f1 is repeatedly performed. Furthermore, when the pen body 32 of the marker 3 is moved away from the writing surface 14 (brought to a pen up state), that is, when the switch 331 is switched off, the coordinate detection by means of the AC signal having the frequency f1 is stopped. Then, a transition to frequency f2 and f3 is, similarly to the above-description, realized.

The data of the switch signals p1 and p2 are, together with the obtained x and y-coordinate data, supplied to the data processing unit 7.

As described above, when the switch signals p1 and p2 representing the frequency of the AC signal are "00" or "01" at the time of obtaining the reception signal, the frequency of the switch signal, that is, the frequency of the AC signal is maintained intact. The reason for this lies in that the cycle of detecting the coordinate when the instruction rod 2 or the marker 3 is used is intended to be shortened as possible for the purpose of improving following-up performance. On the other hand, when the switch signals p1 and p2 representing the frequency of the AC signal are "10" or "11" at the time of obtaining the reception signal, the frequency of the switching signal, that is, the frequency of the AC signal is successively switched. The reason for this lies in that two tuning circuits 46 and 47 having individual frequencies are sometimes operated and their coordinates thereby need to be simultaneously detected when the eraser 4 is used. In addition, the significantly excellent following-up capability is not needed with respect to the marker 3 or the like which writes image. The structure may be arranged such that the signals f0 to f3 are always and repeatedly generated regardless of the results of the coordinate detection although the coordinate-detection speed is slightly reduced.

Then, the operation of the sensing portion control unit 6 will be in detail described with reference to Figs. 10 to 12.

The control circuit 601 resets the above-described quadrual counter (step sp1), transmits the thus-obtained counter data, that is, the switch signals p1 and p2 with the start pulse p3 to the signal generating circuit 602 (step sp2), transmits information for selecting x-direction to the XY switch circuit 605 and the transmission and reception switch circuit 606, transmits information for selecting the first loop coil 11x-1 from the x-direction loop coils from 11x-1 to 11x-48 in the sensing portion 11 to the selection circuit 603x, and connects the thus-selected loop coil 11x-1 to the transmission and reception switch circuit 604x.

The transmission and reception switch circuit 604x alternately connects the loop coil 11x-1 to the drive circuit 610 and the amplifier 61 in response to the above-described transmission and reception switch signal B. At this time, the drive circuit 610 transmits 16 sine wave signals of 600 kHz as shown in Fig. 11A to the loop coil 11x-1 during the signal reception time period of substantially 27 μsec.

The above-described switching between signal transmission and signal reception are, as shown in Fig. 11B, repeated 7 times for one loop coil, where it is 11x-1. The time period in which the signal transmission and signal reception are repeated 7 times corresponds to the selection period for one loop coil.

At this time, an induced voltage can be obtained at the output of the amplifier 612 for one loop coil every reception time period of 7 times. The thus-obtained induced voltages are, as described above, transmitted to the band-pass filter 607 via the reception timing switch circuit 606,

ted to the control circuit 601 via the detector 608 and the low-pass filter 609.

The control circuit 601 inputs the output value from the above-described low-pass filter 609 after A/D converting the same as to store the same as the detected voltage related to the distance between the writing tool or the like and the loop coil 11x-1, for example as Vx1.

Then, the control circuit 601 transmits information for selecting the loop coil 11x-2 to the selection circuit 603x, connects this loop coil 11x-2 to the transmission and reception switch circuit 604x, obtains and stores the detection voltage Vx2 relating to the distance between the writing tool or the like and the loop coil 11x-2, successively and similarly connects the loop coils 11x-3 to 11x-48 to the transmission and reception switch circuit 604x, and stores the detection voltages Vx1 to Vx48 (however, Fig. 11C illustrates only a part of the voltages in an analog-like manner) relating to each of the distances between each of the loop coils as shown in Fig. 11C and the writing tool or the like in x-direction (step sp3).

The practical detected voltages are, as shown in Fig. 12, obtained in several loop coils centering the position (xp) of the writing tool.

Then, the control circuit 601 transmits y-direction selection information to the XY switch circuit 605 and the reception timing switch circuit 606, similarly switches the selection circuit 603y and the transmission and reception switch circuit 604y, and temporally stores the detected voltage relating to each of the distances between the writing tool or the like and each of the loop coils 11y-1 to 11y-30 in y-direction and obtained by A/D-converting the output value from the low-pass filter 609 (step sp4).

Then, the control circuit 601 determines whether or not the level of the detected voltage which has been stored exceeds a predetermined level (step sp5). If it is below the predetermined level, the quadrual counter is stepped by "1" (step sp6), and the above-described steps sp2 to sp5 are repeated. If the same exceeds the predetermined level, the x and y-coordinates of the writing tool or the like are calculated from the thus-stored voltage level in a manner to be described later (step sp7), transmits the thus-calculated coordinates with the switch signals p1 and p2 to the data processing unit 7 (step sp8), and determines whether or not the switching signals p1 and p2 is "00" or "01" at this time (step sp9). If the same are "00" or "01", the process according to steps sp2 to sp9 are repeated with the quadrual counter maintained intact. If the same are "10" or "11", the quadrual counter is stepped by "1" (step sp6), and the processes according to steps sp2 to sp9 are repeated.

nate, for example, the above-described coordinate xp, there is a method in which the waveforms in the vicinity of the maximal values of the above-described detected voltages Vx1 to Vx48 are approximated by an appropriate function and the coordinates of the maximal value of this function are calculated.

For example, referring to Fig. 11C, when the detected voltage Vx3 of the maximal value and the detected voltages Vx2 and Vx4 disposed on both sides of the former are approximated by a quadratic function, the coordinates can be calculated as follows (where it is provided that the coordinates of the central position of each of the loop coils 11x-1 to 11x-48 are x1 to x48 and the distances between the central positions are Δx): first, from each of the voltages and the coordinates,

$$Vx2 = a(x2 - xp)^2 + b \quad (1)$$

$$Vx3 = a(x3 - xp)^2 + b \quad (2)$$

$$Vx4 = a(x4 - xp)^2 + b \quad (3)$$

where a and b represent constants ($a > 0$). Furthermore, the following equations holds:

$$x3 - x2 = \Delta x \quad (4)$$

$$x4 - x2 = 2\Delta x \quad (5)$$

Substituting Equations (4) and (5) into Equations (2) and (3) before rearrangement, the following equation holds:

$$xp = x2 + Dx/2\{3Vx2 - 4Vx3 + Vx4)/(Vx2-2Vx3 + Vx4)\} \quad (6)$$

Therefore, the coordinate xp of the writing tool or the like can be calculated by performing the calculation expressed in Equation (6) by using the detected voltage of the maximal value and the detected voltages in the vicinity of this maximal value which have been obtained at the above-described level check extracted from the detected voltages Vx1 to Vx48 and the coordinates (known) of the loop coil which is disposed forward by one from the loop coil at which the detected voltage of the above-described maximal value has been obtained.

Fig. 13 is a view which illustrates the structure of the data processing unit 7, wherein reference numeral 71 represents a microprocessor (CPU), 72 represents a frame memory, 73 represents a overlay memory, 74, 75, 76, and 77 represent interface circuits which respectively corresponds to the operation switch 51, sensing portion control unit 6, printer 8, and display (omitted from illustration).

Fig. 14 is a flow chart which illustrates the program relating to processing of image information in the data processing unit 7. Image information processing means is formed by this program and the microprocessor 71.

Then, the operation of the data processing unit 7 will be described.

The microprocessor 71 receives data compris-

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ing the x and y-coordinates and the identification information from the sensing portion control unit 6 via the interface circuit 75 (step s1), and determines whether or not the thus-received information is "00" (step s2).

If the identification information is "00", the microprocessor 71 determines that the coordinates at this time are temporal positional data, and causes the character generator (omitted from illustration) to generate a cursor pattern ,for example, an arrow "↑" as to be written in an address in the overlay memory 73 which corresponds to the above-described coordinates (step s3). Since the contents of the overlay memory 73 can be lost if no data is written within a predetermined time period (usually several ms), the above-described address in which the cursor has been written is changed in accordance with the change of the coordinates transmitted from the sensing portion control unit 6.

If the identification information is not "00", it is determined whether or not the same is "01" (step s4). If the identification information is "01", it is determined that the data corresponds to the image drawn on the writing surface 14 by the marker 3 so that bit "1" is written in the address in the frame memory 72 corresponding to the above-described coordinates (step s5). Contents written in the frame memory 72 can be retained if no other data is written therein.

If the identification information is neither "00" nor "01", it is determined that the data is the data for determining a predetermined range on the writing surface 14 to be erased by the eraser 4 so that bit "0" is written in the address in the frame memory 72 corresponding to the predetermined range to be erased and determined by the above-described coordinates (step s6), and the image information is deleted.

When a printing-out switch (omitted from illustration) of the above-described operation switches 51 is operated, the microprocessor 71 transmits the contents of the frame memory 73 to the printer 8 via the interface circuit 76 so that these contents are subjected to a hard copying process.

When a display device is connected, the microprocessor 71 simultaneously reads out the contents of the frame memory 72 and the overlay memory 73 via the interface circuit 77 and simultaneously converts the contents to a video signal as to be transmitted to and displayed on the display device.

When the marker 3 or the eraser 4 is used along the writing surface 14, the contents of the frame memory 72 are rewritten in accordance with the coordinates at that time. When the instruction rod 2 is used on the writing surface 14, or when the marker 3 is used such that the same does not come contact with the writing surface 14, the cursor is written in the overlay memory 73 in accordance with the coordinates at that time. Therefore, image corresponding to the image written on the writing surface 14 is displayed by dots on the frame of the display device, and the position of the instruction rod 2 or the marker 3 pointing an optional position on the writing surface 14 is indicated by the cursor.

Furthermore, data received from the sensing portion control unit 6 can be transmitted to the other electronic blackboard connected by means of an interface circuit, a MODEM and communication lines for the purpose of display the similar image or cursor on the display device of the other electronic blackboard.

As an alternative to the above-described embodiment in which only one type of marker comprising a black felt pen is used, a multiplicity of markers comprising the other color felt pens, for example, red, blue and so on and tuning circuits each of which having individual frequencies may be prepared, these markers being identified from the above-described identification information as to be processed on frame memories corresponding to the multiplicity of colors.

Fig. 15 is a view which illustrates a second embodiment of the electronic blackboard according to the present invention, in which an example of a structure in which two writing surfaces are provided is illustrated. Referring to this drawing, reference numeral 15 represents a frame supported as to be rotatable with respect to the legs 16 with a support shaft 17. Each of the obverse side and the reverse side of this frame 15 can be optionally made face the direction of the surface of this drawing sheet.

The frame 15 is, as shown in Fig. 16, provided with, on both sides of the sensing portion 11 thereof, honeycomb members 151 and 152 made of a non-metallic material such as a synthetic resin or the like, and boards 153 and 154 which are similarly made of a non-metallic material are disposed on both sides of the above-described honeycomb members 151 and 152. The boards 153 and 154 respectively have corresponding writing surface 18 and 19 which can be repeatedly used.

The frame 15 and the legs 16 respectively includes couplers 91, 92, and 93 for the purpose of transmitting information therebetween. These couplers 91 to 93 are arranged such that when either of the two writing surfaces, for example, the writing surface 18 is made face the surface of this drawing sheet, the couplers 91 and 92 confront each other, while when the other one, that is, the writing surface 19 is made face the surface of this drawing sheet, the couplers 91 and 93 confront each other.

These couplers 91 to 93 include, for example, light emitting diodes or phototransistors for the

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optical signals. According to this embodiment, the sensing portion control unit 6 is disposed within the frame 15 (for example, in the circumferential portion of the sensing portion 11) so that information to be transmitted by means of the couplers 91 to 93 becomes the above-described coordinates or identification information.

A metallic member 94 and non-contact sensors 95 and 96 are respectively disposed adjacent to the above-described positions at which the couplers 91 to 93 are positioned in the frame 15 and the legs 16 so that when the writing surface 18 is made face the surface of this drawing sheet, the metallic member 94 and the non-contact sensor 95 confront each other, while when the other one, that is, the writing surface 19 is made face the surface of this drawing sheet, the metallic member 94 and the non-contact sensor 96 confront each other so that detection of the fact which one of the writing surfaces 18 and 19 is being positioned to face the surface of this drawing sheet can be readily performed, that is, a fact that which one is being used can be readily detected. The outputs from the non-contact sensors 95 and 96 are transmitted to the data processing unit 7 via an interface circuit (omitted from illustration).

The power for the sensing portion control unit 6 in the frame 16 is arranged to be supplied through a mechanical and electric contact (omitted from illustration) disposed similarly to the couplers 91 to 93.

According to the above-described apparatus, the vertical positions of the sensing portions 11 are made inverse between the case in which the writing surface 18 is made to face the surface of this drawing sheet and the case in which the writing surface 19 is made to face the same. Therefore, even if the same image has been written, coordinates whose vertical positions are different are output from the sensing portion control unit 6.

Fig. 17 is a flow chart of a program employed in the data processing unit 7 according to the present invention. When data from the sensing portion control unit 6 is received, a fact that which one of the writing surface of the frame 15 faces the surface of this drawing sheet is detected on the basis of the outputs from the non-contact sensors 95 and 96 (step s7) and the vertical coordinate, for example, y-coordinate is used intact or is converted into a value obtained by subtracting this coordinate from the maximal value in the subject direction (step s8). Therefore, according to the present invention, both of the writing surfaces can be used in the same manner regardless of consciousness of recognizing the writing surface.

According to this embodiment, the metallic member 94 and the non-contact sensor 95 and 96 is being used, while, the program and microprocessor 71 shown in Fig. 17 form coordinate conversion means.

The sensing portion described in the first and second embodiments is usually formed by an insulating substrate having a printed conductive pattern as to correspond to the positions of the above-described x and y-direction loop coils. Alternatively, a structure may be employed which is arranged such that a member in which a multiplicity of conductive wires are, at predetermined intervals, held between two insulating films and the thus-held conductive wires are connected to each other so as to correspond to the positions of the x and y-direction loop coils.

The most preferable example is described upon the electronic blackboard apparatus according to the present invention. For example, the loop coil for generating the electric wave and the loop coil for detecting the electric wave may be individually provided. In this case, the structure may be arranged to always generate the electric wave.

Although the structure of the above-described embodiments is arranged in such a manner that one sensing portion performs both the transmission function and receiving function, a structure may be formed such that a transmitting sensing portion and a receiving sensing portion may be individually provided. It is not necessarily critical for the transmission and the reception to be subjected to the time-division treatment. For example, a structure may be arranged such that the transmission side continues the transmission and the reception side detects a predetermined electric wave from the transmission side by switching only the coils of the turning circuit.

In the foregoing, the present invention may be subject to various arrangements, modifications and detailed changes in range that they do not deviate from the spirit. Therefore, the invention should not be understood within the limilted meanings without adhering to the disclosed embodiment in the specification and drawings. The present invention is in the scope of the claims and further protected in the range that it agrees with the spirit.

Claims

1. An electronic blackboard apparatus comprising:

a writing tool (2;3;4) or the like including a tuning circuit (22;33;46,47) which includes at least a coil (221;333,334;462, 472), and in which a predetermined frequency (f_0,f_1,f_2,f_3) is arranged to be the tuning frequeny thereof;

a sensing portion (11) including electric wave gen-

erating means for generating electric wave that can synchronize with said tuning frequency and an electric wave detection means for detecting electric wave reflected by said tuning circuit; coordinate detection means (608,609) for transmitting and receiving signals between said writing tool or the like and said sensing portion for the purpose of detecting, in response to said signals, the coordinate which corresponds to the position assigned by said writing tool or the like; and
image information processing means (7) for processing, on the basis of the thus-detected coordinate, image information which corresponds to images or the like formed on a writing tool or the like.

2. An electronic blackboard apparatus according to claim 1, wherein said electric wave generating means and said electric wave detection means are arranged to be alternately operated.

3. An electronic blackboard apparatus according to claim 1 or 2, wherein said electric wave generating means and said electric wave detection means include x and y-direction loop coil groups (11x-1, ... 11x-48; ... 11y-1, ... 11y-30) arranged to comprise the same loop coil groups.

4. An electronic blackboard apparatus according to claim 1, 2 or 3 further comprising:
a writing tool (3,4) or the like including a tuning circuit (33;46,47) whose tuning frequency is changed from any tuning frequency of a plurality of frequencies to another frequency in accordance with any of a plurality of tuning circuits each of which has an individual frequency or the state of the same;
signal generating means (602) for generating AC signals having individual frequencies;
signal detection means (607) for detecting AC signals having individual frequencies;
writing tool identification means (601) for generating identification information (P_1,P_2) expressing, on the basis of the AC signal detected by said signal detection means from x and y-direction loop coils, the type or the state of said writing tool or the like which is being used on said sensing portion; and
image information processing means for processing image information which corresponds to the image on said writing surface on the basis of the x and y-direction coordinates of said writing tool or the like and identification information expressing the type or the state of said writing tool or the like which is being used.

5. An electronic blackboard apparatus according to claim 1, 2, 3, or 4 further comprising:
writing surfaces (153,154) disposed on both sides of said sensing portion and capable of being used repeatedly;
means (94,95,96) for detecting the surface which is being used for detecting the writing surface which is being used from writing surfaces; and
coordinate conversion means for outputting, intact or after the coordinates have been converted on the basis of the writing surface which is being used, x and y-direction coordinates of said writing tool or the like outputted from said coordinate detection means.

6. An electronic blackboard apparatus comprising:
a sensing portion (11) formed by arranging an x-direction loop coil group(11x-1, ..., 11x-48) in x-direction in parallel and a y-direction loop coil group (11y-1, ..., 11y-30) in y-direction in parallel;
a writing surface (14;153,154) disposed on said sensing portion and capable of being used repeatedly;
a writing tool (2;3;4) ir the like including a tuning circuit (22;33;46,47) which includes at least a coil (221;332;463,473) and a capacitor (222;333,334;462,472) and in which a prede termined frequeny (f_0,f_1,f_2,F_3) is arranged to be a tuning frequency thereof;
x-direction and y-direction selection means (603x,603y) for successively selecting x-direction loop coil group and y-direction loop coil group;
signal generating means (602) for generating an AC signal with a predetermined frequency;
signal detection means (607) for detecting an AC signal which a predetermined frequency;
connection switch means (606) for alternately connecting either of said signal generating means or said signal detection means to said x and y-direction loop coils which are successively selected by said x-direction and y-direction selection means;
coordinate detection means (608,609) for obtaining, on the basis of the AC signal detected by said signal detection means from said x-and y-direction loop coils, x and y-direction coordinates of said writing tool or the like positioned on said sensing portion; and
image information processing means (7) for processing, on the basis of said x and y-direction coordinates, image information corresponding to the image or the like formed on said writing surface.

7. A writing tool (2;3;4) comprising a tuning circuit (22;33;46,47) which is included in a frame (21;31;41) designed to correspond to the purpose or use of said writing tool in such a manner that said tuning circuit is able to be tuned to an electric wave to be transmitted from a sensing portion (11) and said tuning circuit as well returns the energy of the thus-tuned electric wave to said sensing portion.

8. A writing tool (2,3) or the like comprising a tuning circuit (22;33) which includes at least a coil (221,332) and a capacitor (222;333,334) and in which the tuning frequency thereof is arranged to be a predetermined frequency (f_0,f_1), said tuning

(21;31) such that the longitudinal direction of said rod-like frame meets the axial direction of said coil.

9. An instruction rod (2) for an electronic blackboard, comprising: a rod-like body (21) which has a predetermined length at least when used and in which the front portion thereof includes a tuning circuit (22) having the same tuning frequency which is the same as that of electric wave discharged from a sensing portion (11).

10. A marker (3) for an electronic blackboard comprising:
a frame (31) accommodating a pen body (32) with which writing on a writing surface is enabled and a tuning circuit (33) which is consisting of at least a coil (332) including a core, and a capacitor (333,334) and which has a predetermined tuning frequency, wherein a portion of said pen body projects or is capable of projecting over the outer surface of said frame for enabling writing on said writing surface at least when used, and said tuning circuit synchronizes with energy of electric wave discharged from said turning circuit or electric wave generating means and discharges said energy to said electric wave detection means so that writing with said pen body is enabled and the position to be measured is instructed to a sensing portion (11).

11. A marker according to claim 10,wherein said pen body comprises a felt pen capable of being used on a usual whiteboard and available on the market.

12. A marker according to claim 10 or 11, wherein said frame is so formed by at least two detachable components (31a,31b) as to enable to replace said pen body.

13. An eraser (4) for an electronic blackboard comprising an erasing member(45) arranged to have a predetermined area and a tuning circuit-(46,47) whose tuning frequency (f_2,f_3) is arranged to be same as that of an electric wave discharged from a sensing member (11).

FIG.1

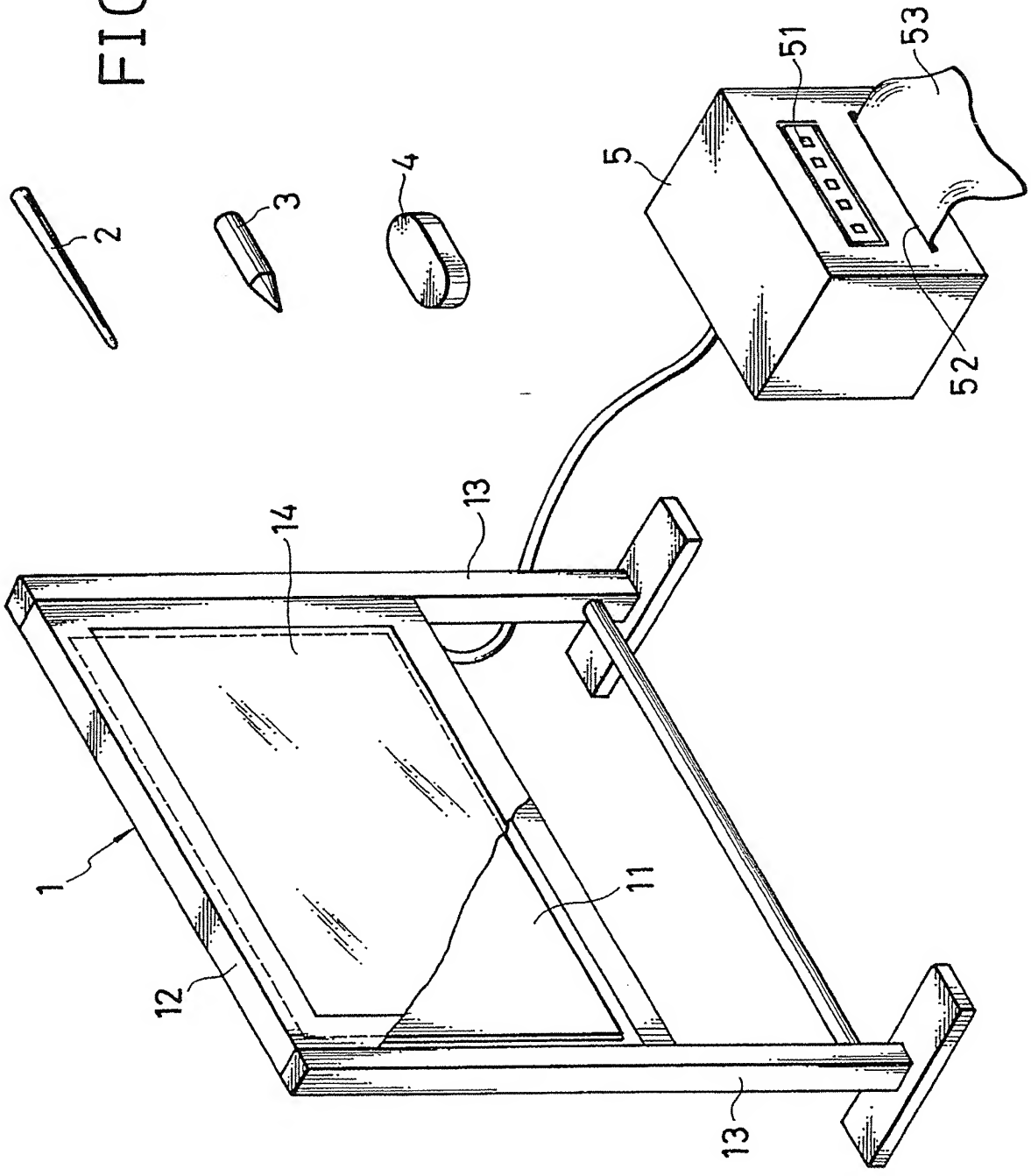

FIG. 2

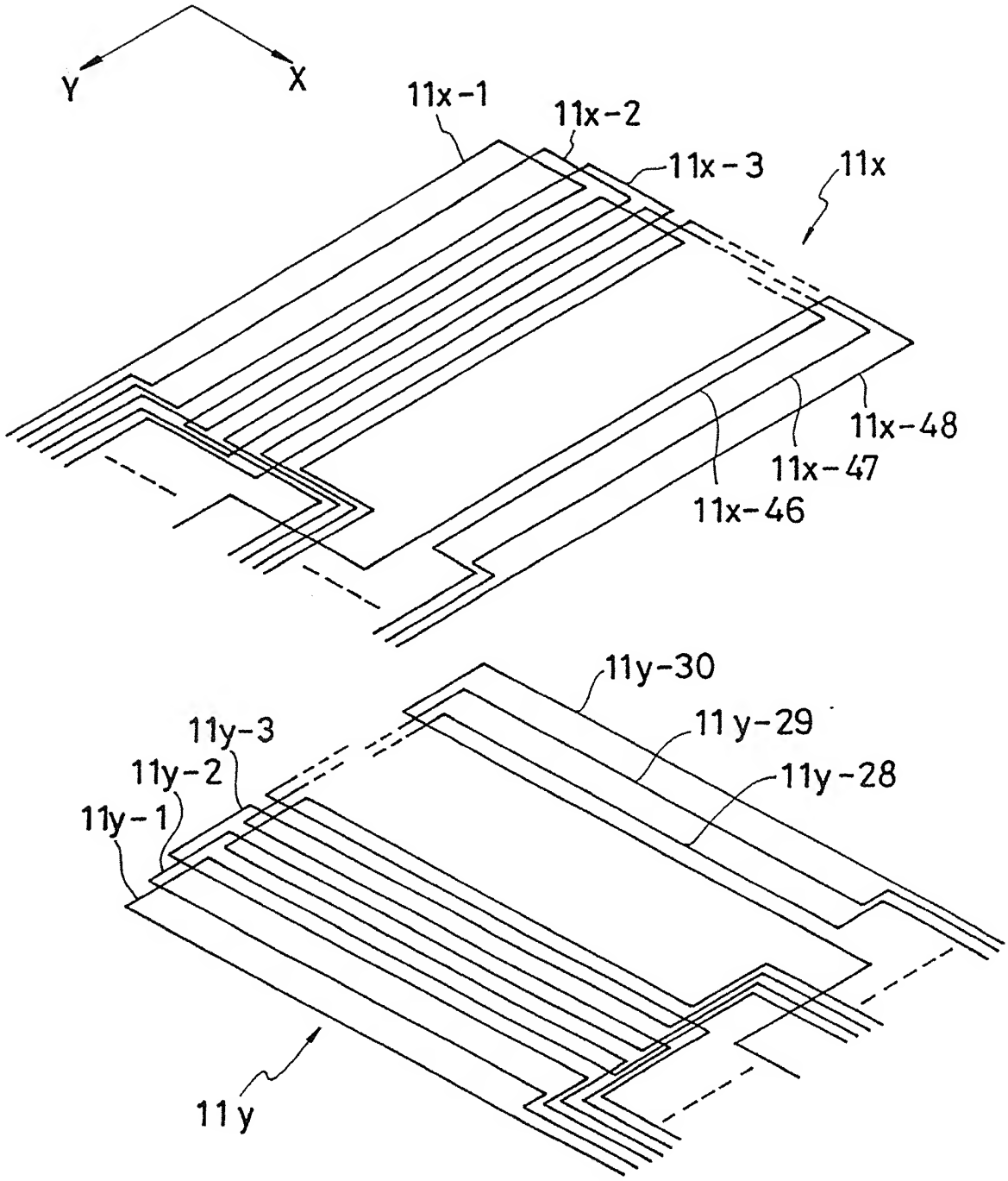
Y
X
11x-1
11x-2
11x-3
11x
11x-48
11x-47
11x-46
11y-30
11y-3
11y-29
11y-2
11y-28
11y-1
11y

FIG.3

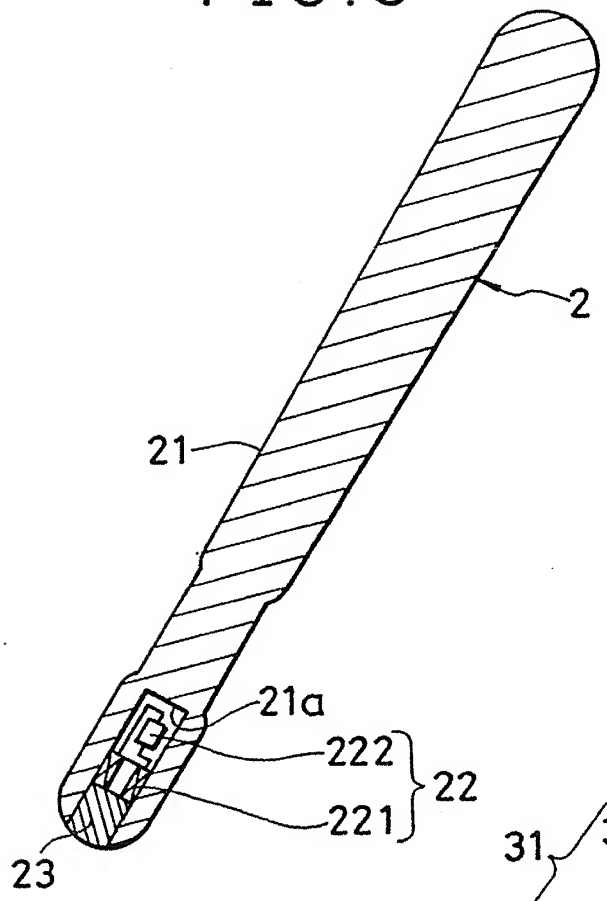

FIG.4

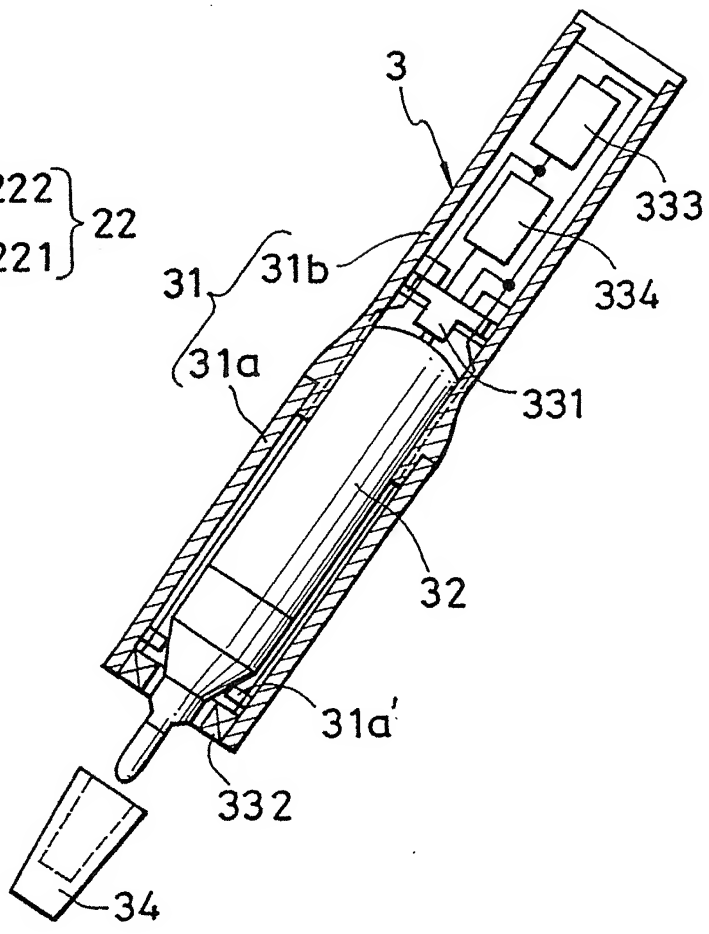

FIG. 5

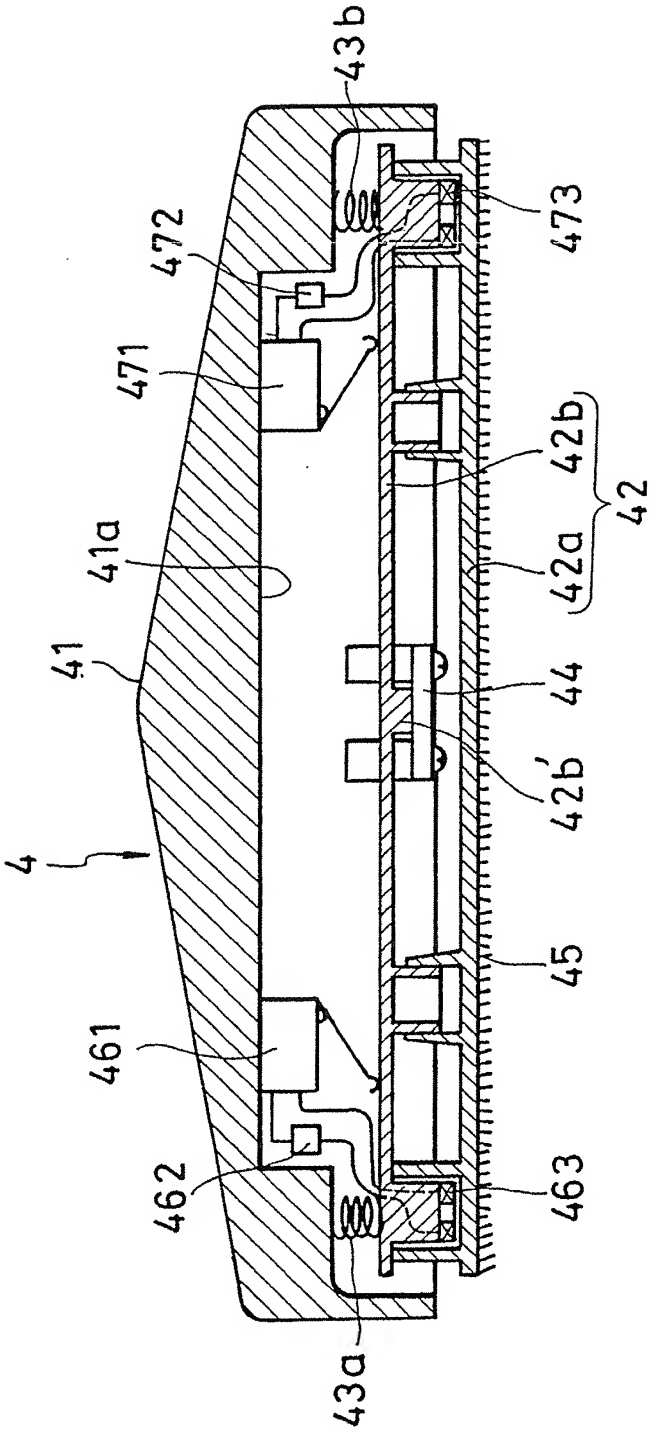

FIG. 6

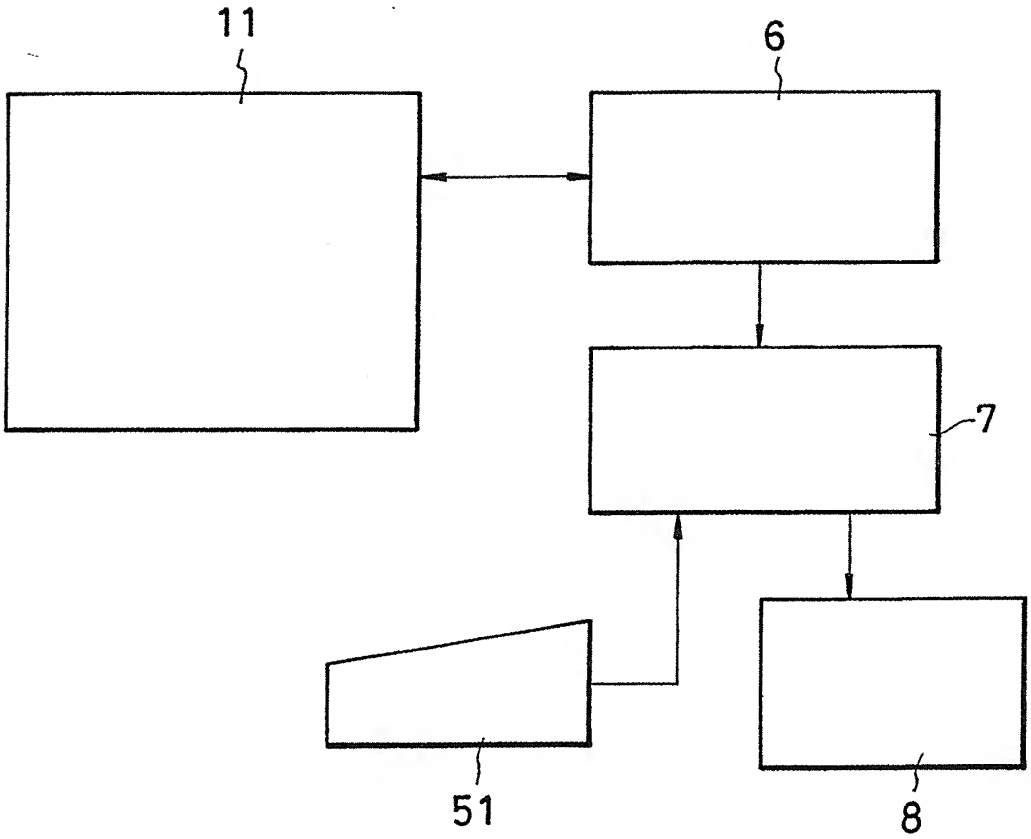

FIG. 7

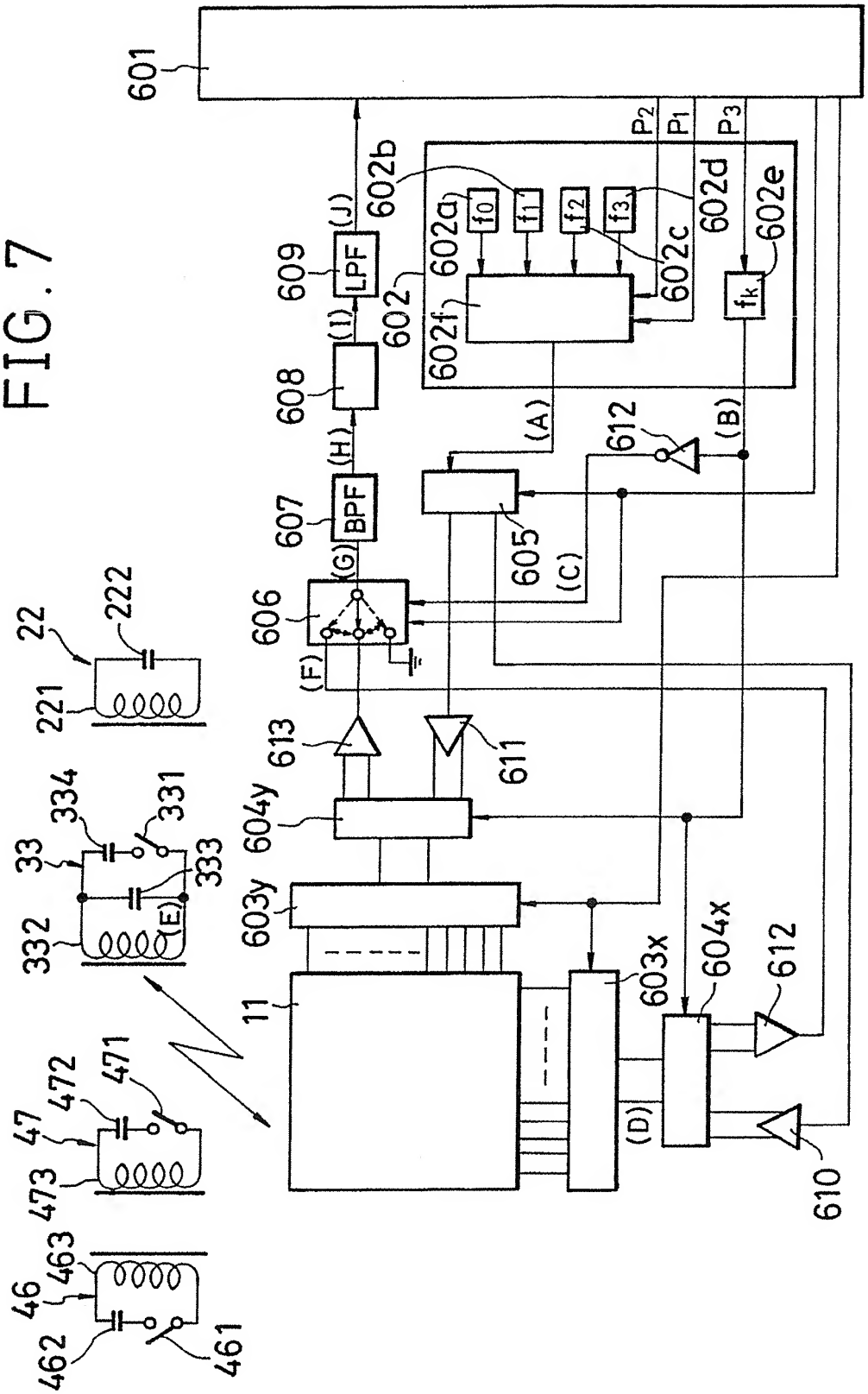

FIG. 8

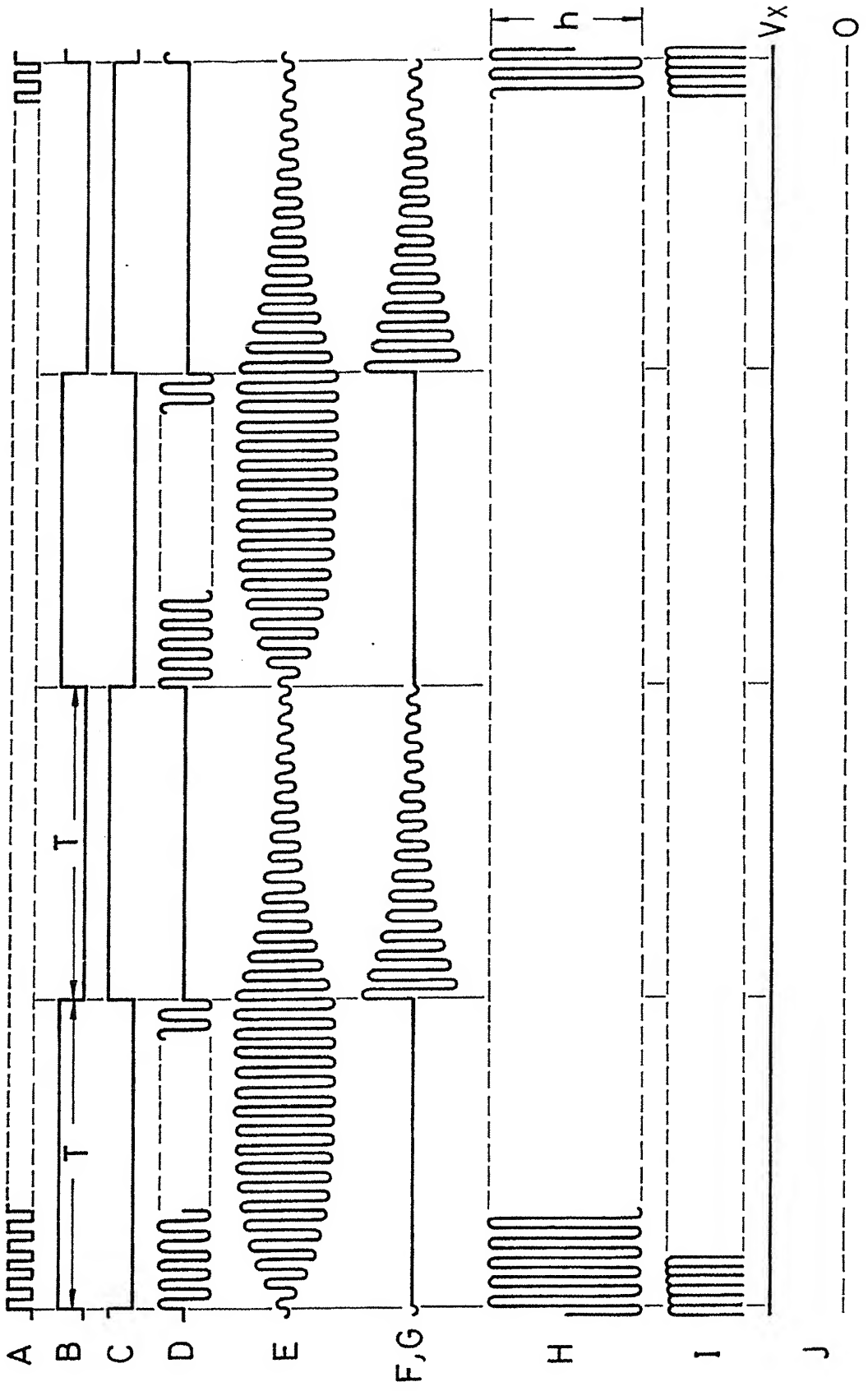

FIG. 9

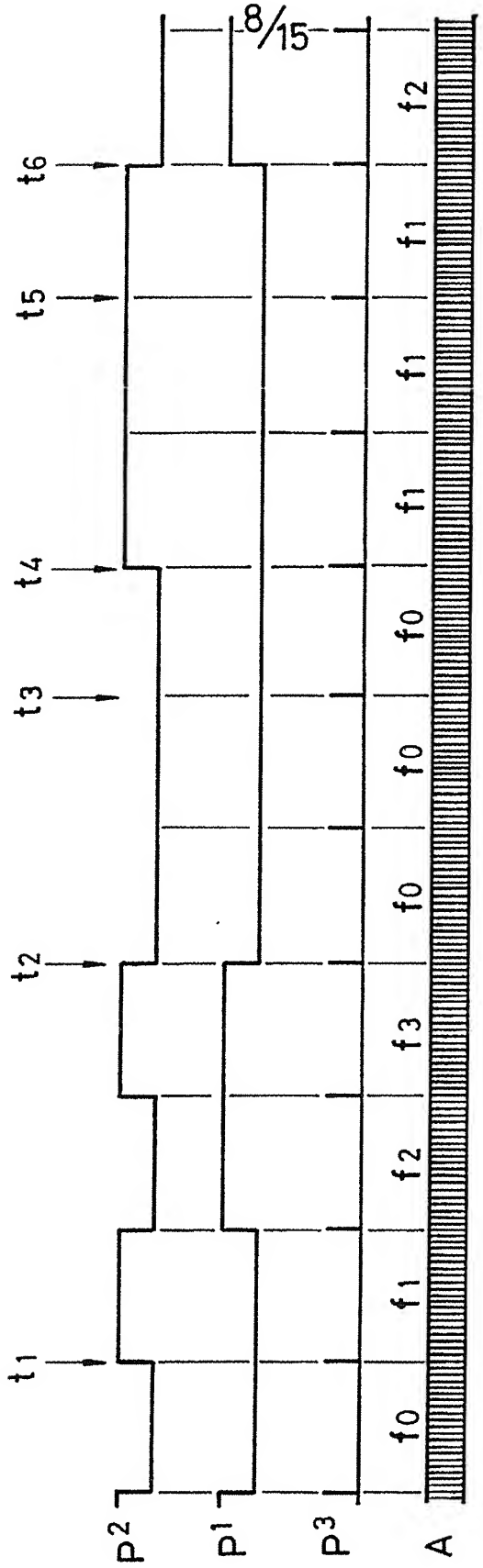

FIG.10

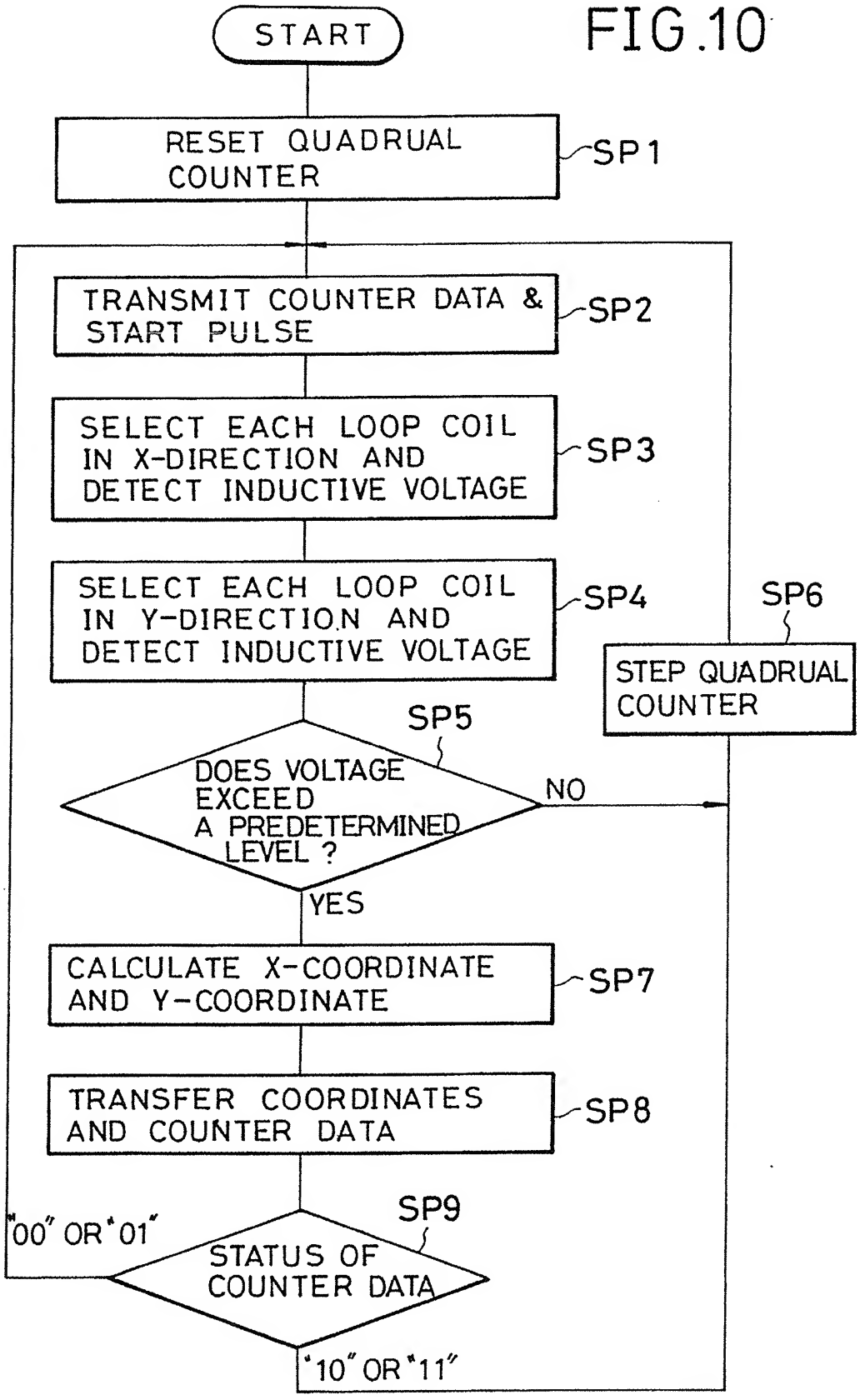

FIG.11

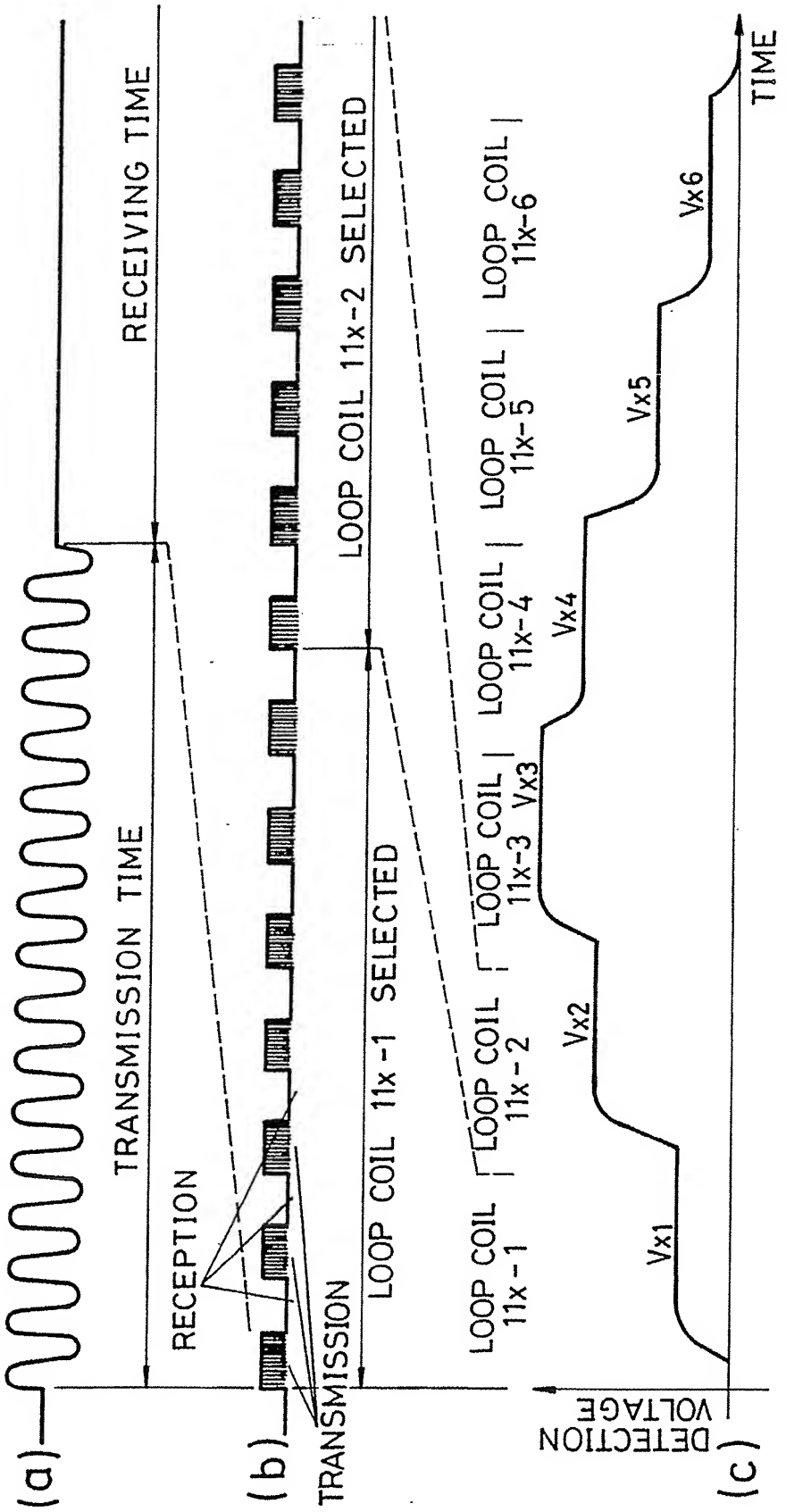

FIG.12

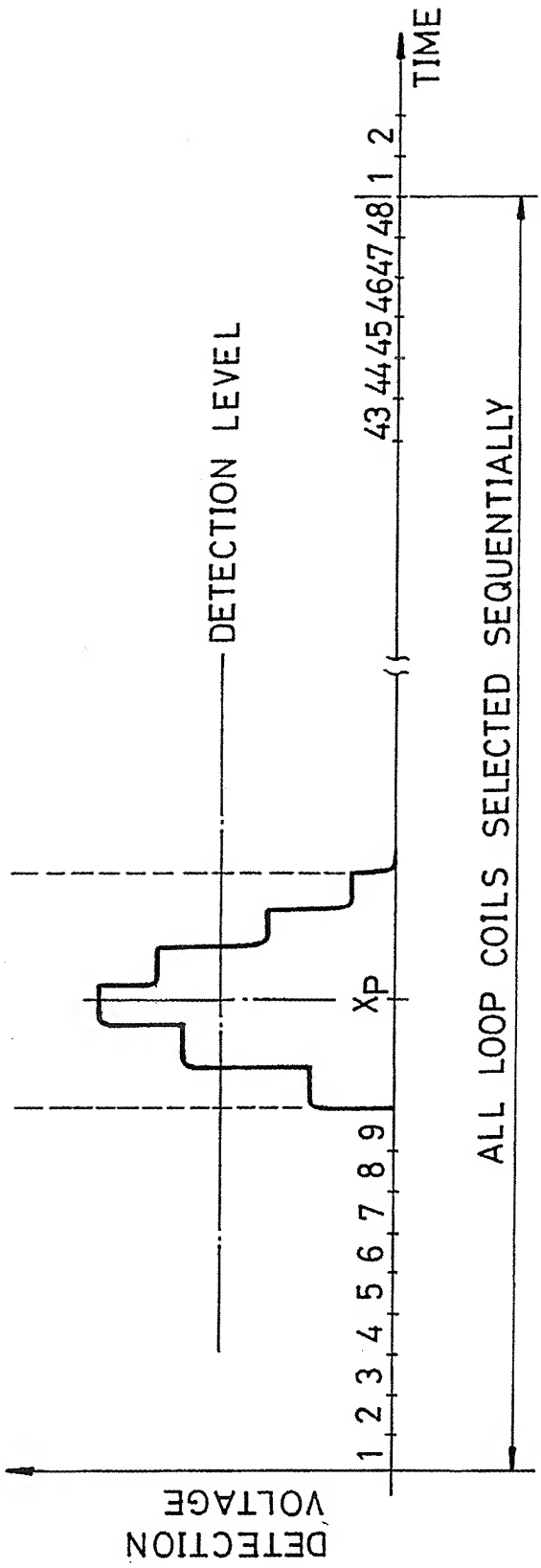

FIG. 13

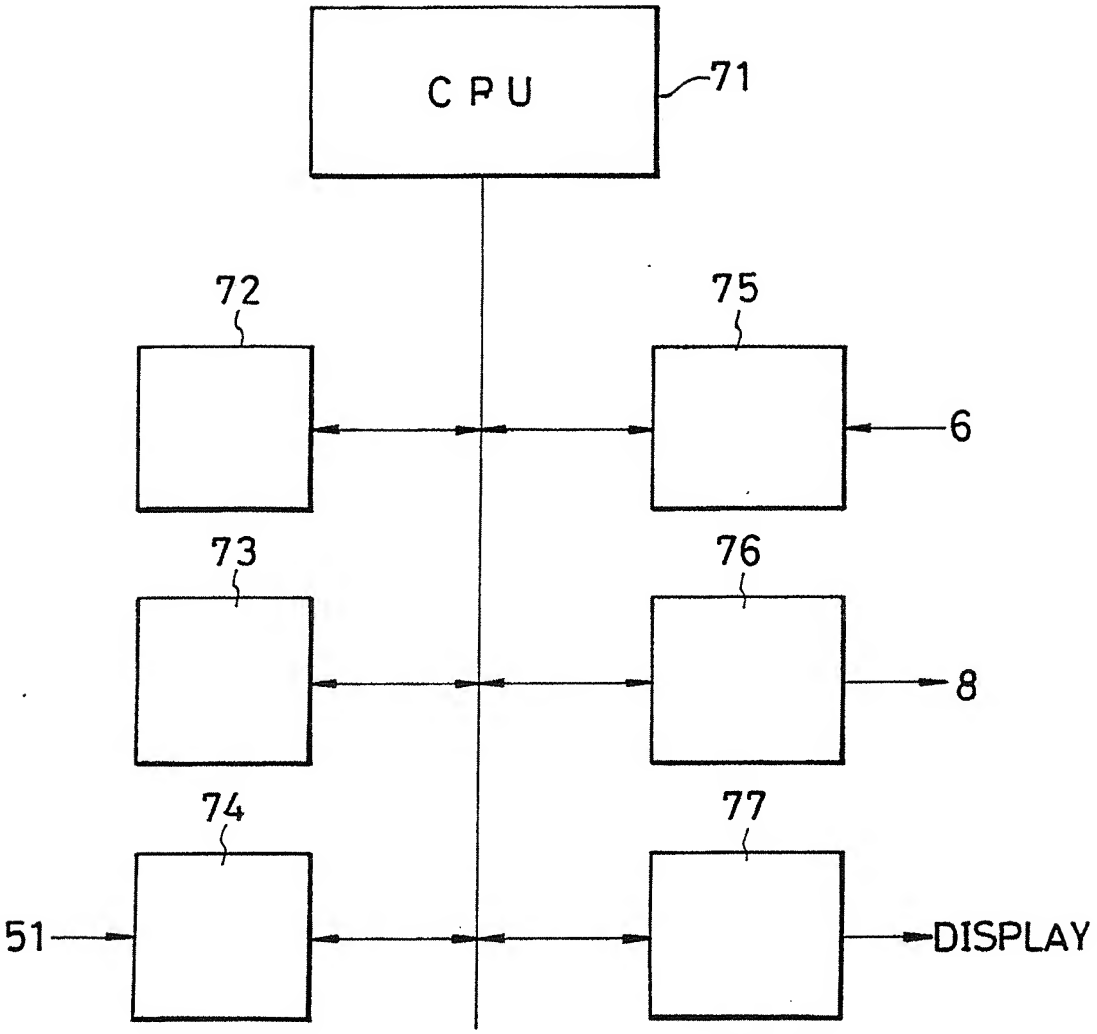

FIG.14

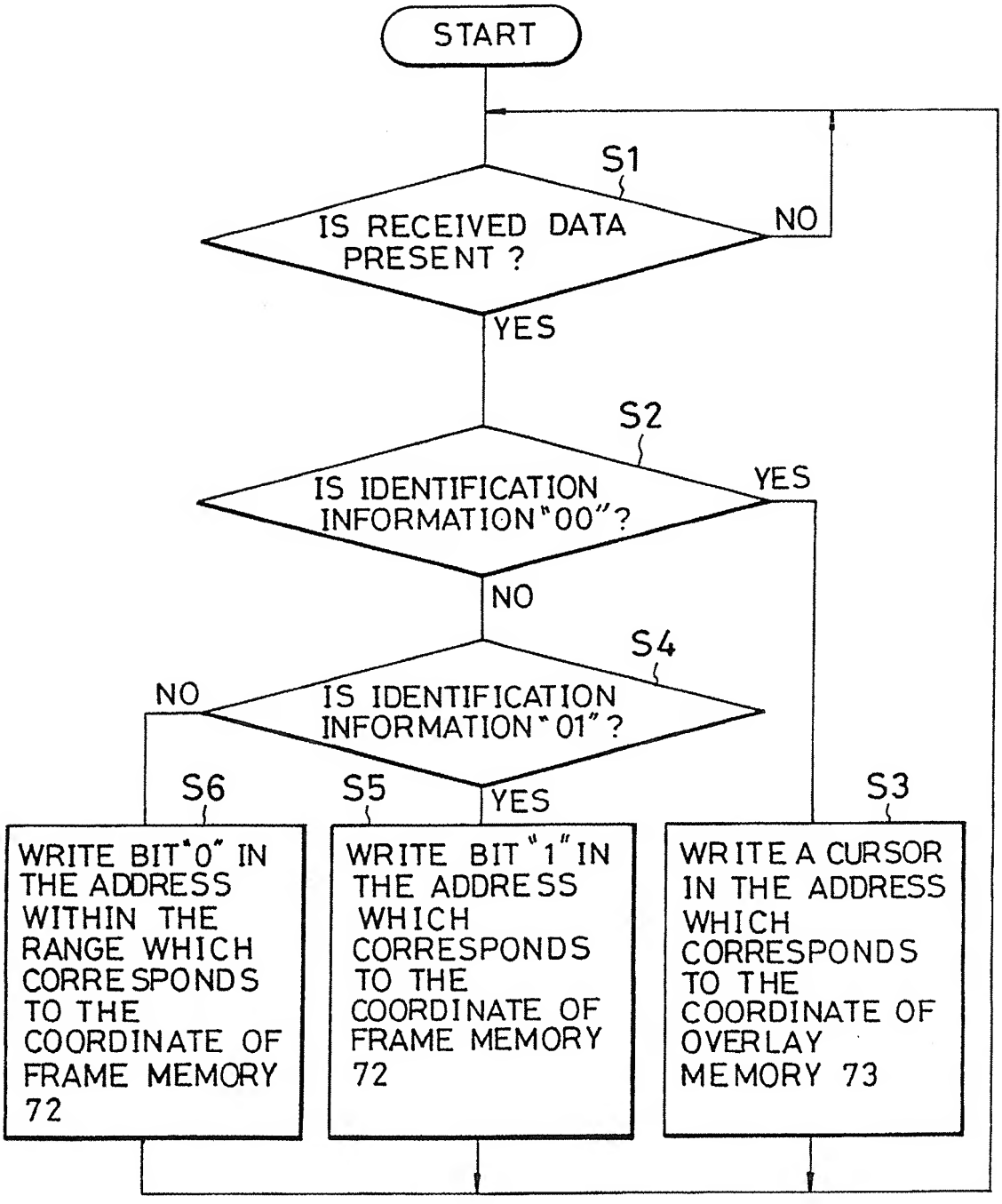

FIG.15

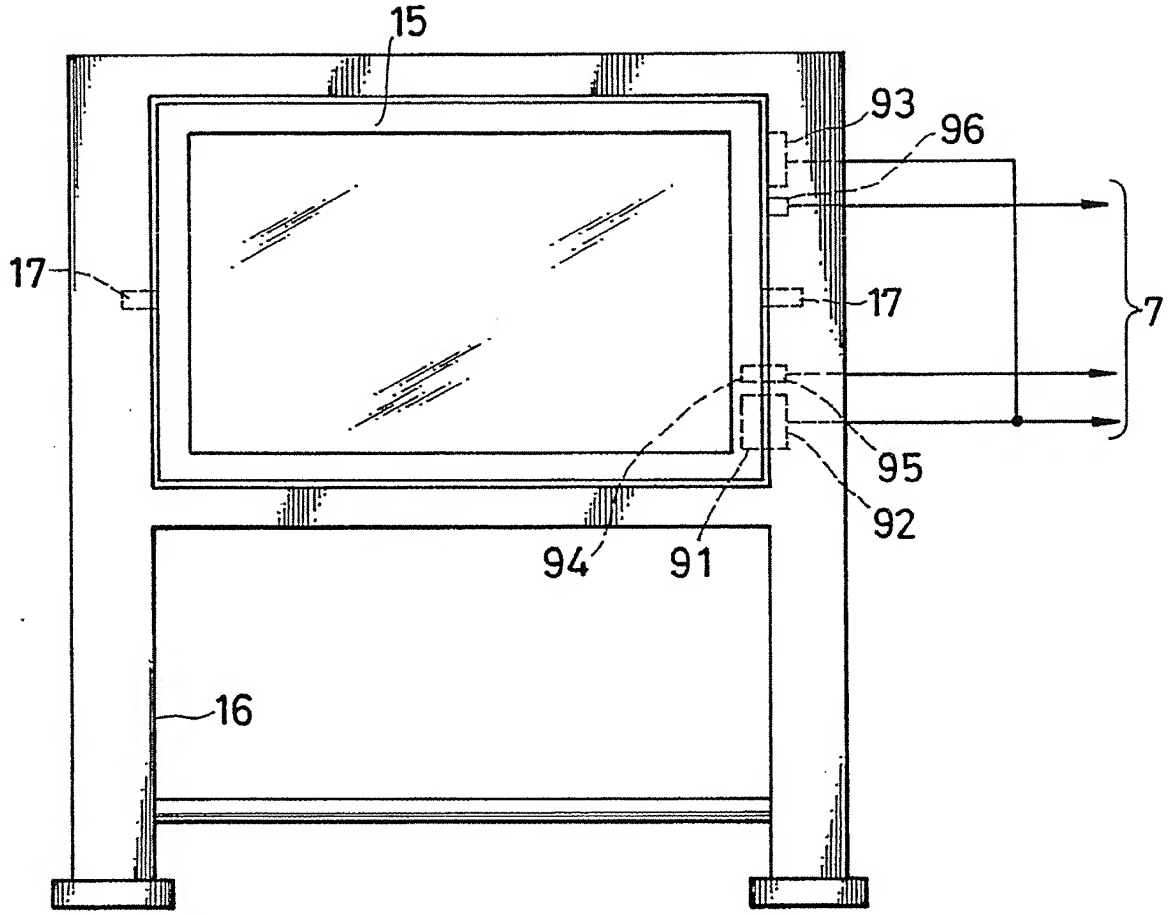

FIG.16

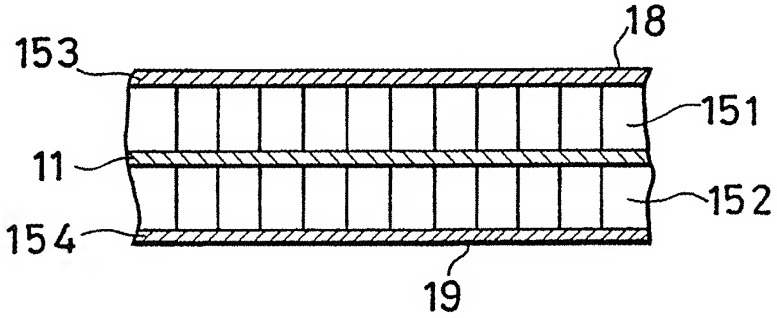

FIG.17